Methods to Increase the Insect Resistance of Food Shipping Cases

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ABSTRACT

Four methods used to reduce insect infestation in bulk packed raisin cases reduced infestation from 51 to 95 percent. The simplest method involved inverting the case so the folded top of the liner was on the bottom. This reduced the infestation rate by 61 percent. In tests with shipping cases containing cartons of raisins, taping the seams, using a 1.5-mil polyethylene liner, a 1.5-mil shrink wrap outer liner, or overwrapping individual cartons with a 1.7-mil polyethylene overwrap, all reduced infestation. The last method was most effective.

KEYWORDS: Insect resistant packages, stored product insects, infested packages, raisins, bulk shipping.

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METHODS TO INCREASE THE INSECT RESISTANCE OF FOOD SHIPPING CASES

By Albert P. Yerington

INTRODUCTION

Most packaged food is shipped in corrugated fiberboard shipping cases. The dried fruit industry uses a similar case to bulk pack their product for shipment Although the cases were developed primarily to protect cartons in shipment and storage from rough handling, only minimum efforts have been made to make the cases insect resistant. This paper evaluates methods used by the dried fruit industry and demonstrates some new ways to improve the insect resistance of shipping cases. Although this paper deals only with dried fruit, the principles used here can be adapted for many other food products.

MATERIALS AND METHODS

Two kinds of cases were tested--regular slotted containers (RSC) and Pak-Master® cases. The regular case is made of 5/8-inch corrugated board with a bursting strength of 200 lb/in and inside dimensions of 11 by 8-1/2 by 11-1/2 inches. Each case holds two 12-carton layers. The Pak-Master® case measures 12 by 14 by 6 inches and is made of similar corrugated board but is of the wrap-around type and, therefore, has no major or minor flaps. (The edges of the Pak-Master® are sealed while the case is being wrapped around a single layer of 24 cartons.)

Materials tested included (1) the inside liners for bulk packed raisins, which usually consist of a 1.5-mil polyethylene (PE) bag folded on the top; (2) the same liner folded but turned upside down in the case; (3) the same liner heat sealed at the top; (4) a 2-mil PE liner folded on top; (5) the same liner folded and inverted; and (6) a 2.5-mil PE liner heat sealed.

Regular cases containing cartons of raisins were tested with six modifications. The modifications were (1) cases that were laid sideways, (2) all seams taped with a polyvinyl chloride latex tape, (3) only the middle seam taped, (4) a 2-mil PE inner liner, (5) a 1.5-mil PE external shrink wrap, and (6) all cartons in the case overwrapped with a 1.7-mil Saran-cello-polypro-cello-Saran film. Cartons used in the test were regular 15-oz bleached boardcoated on each side

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with 1-mil PE. Cartons were moderately tight.

Pak-Master® cases were tested (1) in an upright position, (2) with a 2-mil sealed inner liner, and (3) with the side seam taped.

All cartons and cases used in these tests were filled with processed Thompson Seedless raisins on regular commercial packaging lines. Bulk pack cases were filled with 30 lb of raisins, and cartons were filled with 15 oz of raisins.

We evaluated cartons for insect resistance by placing them in one of two exposure rooms containing large numbers of stored product insects (fig. 1), withdrawing cartons at intervals of 1, 2, and 3 months, inspecting cartons for infestation, and recording insect counts.

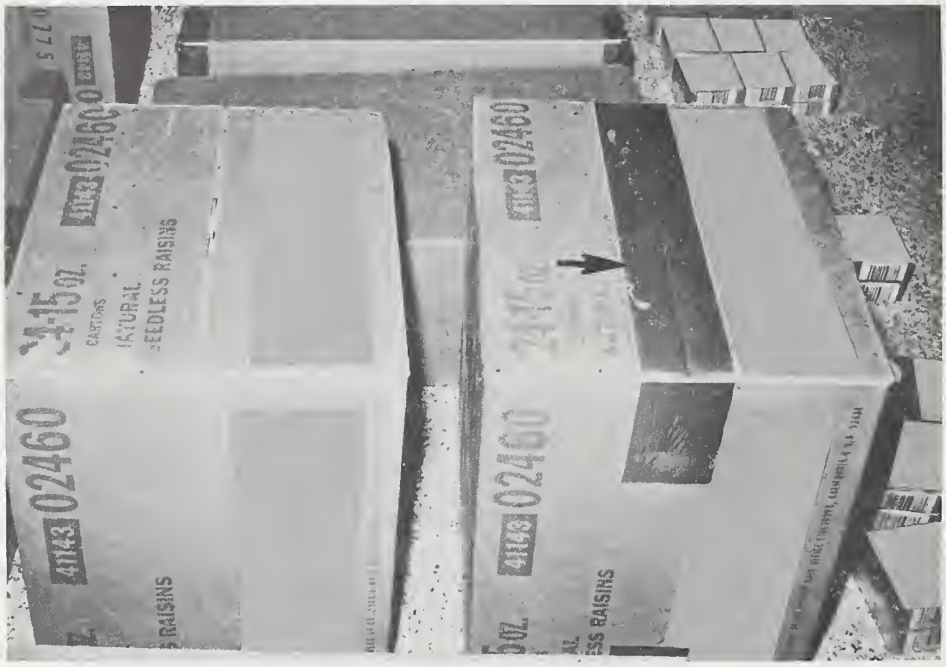

Figure 1.--Two types of regular shipping cases, taped (right) and untaped (left), undergoing tests in the insect exposure room. The small black objects are live insects. (Two Pak-Master® cases appear in the background.)

Approximately 24,000 insects, consisting of nine species of insects commonly associated with stored food products, were released biweekly in each room. Species of insects and approximate numbers released are shown in table 1.

For evaluating 30-lb bulk packed regular raisin cases, two cases of each liner type (see table 2) were examined at the end of 1, 2, and 3 months of exposure to insects. The cases were brushed free of insects in the exposure rooms and taken to the laboratory. Two 1-lb samples of raisins were taken from the top of each case. The case was then inverted, and two samples were taken from the bottom, after which 4 inches of raisins were removed, and two more samples were taken from the middle of the case. All six samples were examined, and all insects were counted.

Table 1.--*Names and approximate numbers of insects released biweekly in packaging-exposure room*

Scientific name	Common name	Insects released
		Number[1]
Oryzaephilus mercator (Fauvel)	Merchant grain beetle	5,800
Oryzaephilus surinamensis (Linnaeus)	Saw-toothed grain beetle	5,800
Plodia interpunctella (Hubner)	Indian-meal moth	1,800
Sitophilus zeamais (Motchulsky)	Maize weevil	1,000
Tribolium castaneum (Herbst)	Red flour beetle	3,000
Tribolium confusum (Jacqueline duVal)	Confused flour beetle	2,000
Trogoderma glabrum (Herbst)	None	1,000
Trogoderma inclusum (LeConte)	None	1,000
Trogoderma variabile (Ballion)	None	1,000

[1]Total number of insects released was 22,400.

Table 2.--*Effect of various polyethylene liners on numbers of insects found in 30-lb bulk packed regular shipping cases of raisins*

Liner type	Insects per pound of raisins[1]			Average insects per pound	Reduction in insects
	1 month	2 months	3 months		
	Number	*Number*	*Number*	*Number*	*Percent*
1.5 mils folded on top (Control)	140	129	82	117	---
1.5 mils folded and inverted	14	67	58	46	61
1.5 mils heat sealed	6	73	92	57	51
2 mils folded on top	100	108	142	117	0
2 mils folded and inverted	4	37	54	32	73
2.5 mils heat sealed	16	2	0	6	95

[1]Average count for 6 1-lb samples.

The two exposure rooms mentioned on the previous page are identical: They measure 12 by 12 by 8 feet and have cement floors and a single 100-watt light fixture in the center of the ceiling, which operates on a 12-hr on-off cycle. The rooms are maintained at 80° ±5°F, and 40 to 50 percent relative humidity. The floors, except for a 2-ft corridor around the perimeter, were covered with 0.5 to 1 inch of used food media in which the liberated insects had been reared. Very little food value was left in this media, which served mainly as a cushion on which the test cases were placed.

RESULTS AND DISCUSSION

Bulk Pack Shipping Cases

Bulk packed raisins are normally shipped in a 1.5-mil PE bag placed within the shipping case with the bag merely being folded on top. Insects infested the raisins by entering through the folds of the liner. All treatments (table 2) produced significant reductions in infestation rates except for the 2-mil folded liner, which had results identical to those produced with the 1.5-mil standard liner. Some of the thinner liner cases showed penetration holes in the liner. A slight increase in thickness (0.5 to 1 mil) produced less infestation by penetration. A 2.5-mil sealed liner produced a 95-percent reduction in the numbers of insects per pound, that is, 6 insects per pound compared with 117 insects per pound for the 1.5-mil liner.

By inverting the case or the liner in the case, the weight of the raisins on the folds of the liner made it more difficult for insects to enter. This method reduced the infestation rate in our study by 61 percent and is now being used by about half of the raisin packers because they can easily flip the cases while stacking them on pallets or slip-sheets.

Shipping Cases with Cartons

Raisins in cartons are usually shipped in two-layered corrugated shipping cases, 24 cartons to the case. Very little has been done to improve the insect resistance of shipping cases, the packers preferring to depend upon the individual cartons for that purpose. The author has shown in a previous paper[2] that cartons are not completely insect proof; therefore, a number of methods were tested to improve the resistance of the cases (table 3).

The placing of a case on its side was the only situation in which infestation rates increased. The reason for the increase was that the weight of the cartons placed on their sides forced the end seals open. This was verified by testing cases with a Seal Quality Meter.[3] Cartons with sealed ends vertical tend to be tighter because of the weight exerted on them. All other methods that were tested showed improved insect resistance although not complete elimination of insects.

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[2]Yerington, A. P. The insect resistance of dried fruit packages. Modern Packaging 44(6):76, 77, 78. 1971.

[3]Yerington, A. P. Insects and package seal quality. Modern Packaging 51(6):41-42. 1978.

Table 3.--*Results of methods used to increase the insect resistance of shipping cases containing cartons of raisins*[1]

Case description	1 month		3 months		All infested cartons	Total insects
	Cartons infested	Insects[2]	Cartons infested	Insects		
	Percent	*Number*	*Percent*	*Number*	*Percent*	*Number*
Standard (regular):[3]						
Upright positions	88	698	88	1,834	88	2,532
Lying on side	96	2,821	100	2,660	98	5,481
All seams taped	21	8	67	932	44	940
Only middle seam taped	71	489	71	788	72	1,277
2-mil PE inner liner	17	17	71	309	44	326
1.5-mil external shrink wrap	29	68	62	414	42	482
Individual cartons overwrapped	21	16	21	17	21	33
Pak-Master®:[4]						
Upright	79	863	79	1,070	78	1,933
2-mil, sealed inner liner	38	19	67	110	52	129
Side seam taped	58	604	75	889	67	1,493

[1]Cases contain 24 15-oz cartons of raisins.
[2]Total insects for 24 cartons.
[3]Contains 2 layers of cartons.
[4]Contains 1 layer of cartons.

The greatest reduction in infestations occurred when individual cartons were overwrapped and nothing was done to the cases. This would seem to support the packers' contention that the carton is the most important factor in reducing infestations. Individual overwrapping is expensive, however, and in many instances does not give that much additional protection. In this study, the number of insects in the case was reduced by 99 percent, but 21 percent of the cartons were still infested even though the tightness of cartons was increased 63 percent according to Seal Quality Meter readings.

The percentage of infested cartons was equal when an inner seal liner was used, all seams were taped, or the case was shrink wrapped. When only the slits between the major case flaps were taped, insects were still able to enter along the sides.

The Pak-Master® cases tested showed results similar to those of the regular cases, but reduction in the number of infested cartons was not as great.

CONCLUSIONS

Since all methods tested did increase the insect resistance of all shipping cases, the cost of the method and the difficulty in setting up machinery would probably be the factors that decide which method should be used.

Although all of these tests were made with raisins, many of the methods used could be adapted to many of other packaged foods with similar results.

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